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SYNTHETIC INSECTICIDES

The shortage of nicotine and other contact insecticides has stimulated research.

Lethane—In particular Lethane B-71 and Lethane B-72 have come into use for controlling aphis and leafhoppers on potatoes. Lethane B-72 is used at the rate of 2½ to 3 pounds to 100 gallons of water and assures almost complete kill of leafhoppers, showing a killing power equal to nicotine, rotenone and pyrethrum. Lethane B-71 is a dust concentrate. Lethane B-72 is for spray. Lethane B-71 may be combined with such stomach poisons as cryolite, arsenate of lead, calcium arsenate.

NEW ORGANIC FUNGICIDES

Fermate—This is an iron salt of dimethyl dithiocarbamic acid. It is insoluble, dark in color and goes into suspension in water. It is used generally at the rate of 1½ to 2 lbs. per 100 gallons of water. It is effective in controlling most apple and peach diseases. It is very effective on cedar rust on apples, also cherry leaf spot and brown rot, pear scab, fruit rots of cranberries, etc.

Fermate is compatible with most types of wettable sulfurs, arsenate of lead, (and is regarded as making the use of arsenate of lead more safe) calcium arsenate, nicotine, rotenone, DDT, oils, and to a limited extent hydrated lime. It is not compatible with most metallic compounds such as those containing copper and mercury, lime sulfur, and to a certain extent hydrated lime. It can be used with summer oil for codling moth control and in itself it will tend to control scab and other diseases of the apple. It is not very much affected by climatic conditions. Hence it is safe on more types of foliage than either present types of sulfur or copper compounds. It does not cause russeting and it controls bitter rot.

Methasan—It is a zinc salt of dimethyl dithiocarbamic acid. It differs from Fermate in that Fermate contains iron where in Methasan this is replaced by zinc. It is a white, insoluble material and goes into suspension in water with the aid of a wetting agent. It has about the same properties as Fermate and is used at the same concentration of active ingredient. For the control of scab and cherry leaf spot it is not quite equal to Fermate but on vegetables that are zinc resistant as potatoes, tomatoes, it has proven superior. There are other zinc-carbamic acid products that have not been given trade names, so that more may be expected in this field.

Dithane—is sodium ethyl bis dithiocarbamic acid. It is yellowish in color and can be purchased in a crystalline form or in solution.

Puratized N-5-E—This is a complex compound of mercury and is an entirely new type of fungicide. In its present form, containing 22% of active ingredient, it is used at the rate of one-half pint per hundred gallons of water, which gives an actual mercury content of the diluted spray of about 1 to 8000. It is effective on most apple diseases and gives excellent control of scab and bitter rot. Also it is excellent for most potato diseases and some tomato diseases. Care will have to be used in its application on foliage to make sure that the dilution is not too strong, for the foliage of plants vary. No dilution is safe for roses.

It goes into suspension or dilution well and it is claimed to be electrically positive, while the leaf surfaces are electrically negative, thus causing the chemical to become firmly attached. The claim that it is actually absorbed into the epidermis of the leaf seems to be well-founded for the results definitely indicate that it has curative value and apple foliage sprayed three or four days after scab infection shows no subsequent scab growth. It is compatible with arsenate of lead, hydrated lime, calcium arsenate, nicotine, and DDT. It is effective in controlling fire blight, black rot, bitter rot, blotch, black knot of plum, anthracnose of brambles, and many others.

The limiting factor to its use is that the Food and Drug Department will not give any tolerance whatsoever to mercury; therefore it cannot be applied after the fruit is well formed. It may be applied for the pre-bloom stage for controlling apple scab and as an eradicant for many types of fungi and bacteria and if it had been available this year and applied to the apple trees in the East which are carrying no crop it would have cured scab and assured vigorous trees for 1946. It offers great promise for control of scab to the time of pre-bloom and perhaps immediately following bloom which would be of great importance in many regions.

Isothan Q-15—This is a quarternary ammonium compound. It contains no mercury or other metals. Its chemical name is lauryl isoquinolinium bromide. It has a wine color and is sold in liquid form. It is used one pint to 100 gallons and it seems to be safe on apple and cherry foliage at that strength. The reports indicate it is moderately effective against apple scab and cherry leaf spot. It is a strong wetting agent. Its uses tend to lessen arsenical injury.

Effect on size—The use of these organic compounds seems to tend to increase the size of the fruit. That is, as compared with Bordeaux mixtures which tend to check the size of fruits in the case of apples.

We may expect an increasing number of new organic fungicides.

RECENT DEVELOPMENTS IN APPLE PRODUCTS

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The large proportion of the apple crop utilized in the form of processed products—amounting to an estimated 28 per cent in the case of the 1944 crop[2]—requires that attention be given to this method of merchandising apples. At last year's annual meeting, John E. Dodds presented an estimate of the distribution of the year's processed apple products. This is reproduced in Table I. In 1943[2] with a short crop of 88 million bushels, 33 per cent or 29 million bushels were used in manufacture. In analyzing such reports one must be careful to avoid overlapping of products. Much vinegar is made from cider pressed from peels and cores obtained as cannery waste. Jelly and apple butter are rarely made from fresh fruit but mostly from concentrated juice and from chops and boiled cider. An estimate of crop utilization should include primary products only.

By withdrawing certain grades of fruit from the fresh market, processed apples exert a beneficial influence on the quantity and quality and therefore the price of market fruit. Extension and diversification of products increase the stabilizing effect which apple products exert on the marketing of fresh fruit. The apple industry is just as much interested in the orderly sale of apples for processing as it is in the sale of fruit for the fresh market. Proper balance of supply prevents the apple grower from receiving less net return for fruit made into sauce by the canner than from fresh fruit of the quality which the housewife uses for sauce. Research on new products and on product improvement can lead to increased demand for fruit for processing and strengthen this bulwark against market gluts.

Apple product research in the United States Department of Agriculture has centered around six or seven main products: juice, sirup, essence, full-flavored concentrate, frozen slices, pomace, and pectin. Let us consider each of these in detail.

1/ One of the laboratories of the Bureau of Agricultural and Industrial Chemistry, Agricultural Research Administration, United States Department of Agriculture.
2/ U. S. D. A. data.

JUICE

A great tonnage of apples is ground and pressed, resulting in juice and pomace. In many cases the process stops right there, the juice without further treatment being drunk within a few days, and the pomace being thrown away or fed to stock. Sizable industries, however, have been built on the further treatment of both the juice and the pomace. For example, some 4 to 6 million gallons of juice are canned or bottled annually in this country and at least 1.5 million gallons in Canada. Many further millions are converted into the various products shown in the chart, such as vinegar, concentrated juice, wine, brandy, and sirup.

The problem in processing juice is to preserve the delectable quality of the fresh juice until the next summer, when we are looking for thirst quenchers. Many factors can enter into the item called "quality," which we define as "typical apple flavor." A few years ago we made surveys of all the apple juice commercially processed in this country, obtaining and classifying information on the varities of apples, kind of storage, container, method of sterilizing, and sugar, acid, and tannin content, then judging the samples for typical apple flavor on a scale of 1 to 5. Unfor-

tunately, from the data we couldn't determine exactly what items made a good or a poor juice, but certain trends were evident. From these and other data we can generalize as follows: A manufacturer can expect to produce, and to have eight months later, a good-quality juice if he uses good apples in the first place; if the acidity of the juice is between 0.5 and 0.6 per cent; if he leaves the juice cloudy instead of filtering it clear; and if he handles it promptly, with as little time as possible between press and container, packs it in enameled tin or glass, and stores it in a cool place.

It might be of interest to describe the "typical U. S. apple juice," that is, the composite of all juices submitted in the survey. It can be described as follows: It was made from a blend of Baldwin, Red Delicious, Jonathan, Northern Spy, and Winesap apples taken from common storage. The Brix was 13.5; the acidity, 0.5 per cent; the tannin content, 0.01 per cent. It was clarified by enzyme treatment. It was not deaerated. It was pasteurized at 185° F., and was packed in 20-ounce enameled cans. After 6 months' storage it was weak in typical apple flavor. The plant that made this juice had a capacity of 70,000 gallons per month, and it made a total of 100,000 gallons during the season.

A persistent difficulty encountered in canning apple juice, regardless of whether or not an attempt is made at clarifying, is the formation of a precipitate in the container after pasteurization. Naturally this is especially noticeable when juice is packed in glass, but it is present to the same extent in juice packed in tin. Research on this problem has been temporarily shelved in favor of problems of greater wartime significance, but it is hoped that the problem will soon receive further attention.

Ascorbic acid is largely lost in the extraction of apple juice by the conventional hydraulic press method. This is due to the action of oxidizing enzymes before inactivation during pasteurization. In Canada ascorbic acid must be added to all processed apple juice to give it substantial vitamin C activity. As a special precaution to prevent loss, the ascorbic acid is added just before the container is closed. The fortification of apple juice has not yet been undertaken commercially in the United States. In the Schwarz process of preparing crushed apple juice the ascorbic acid is largely preserved. The disintegration is conducted under vacuum, and the juice is immediately pasteurized without exposure to the air.

Some method is needed for extracting apple juice by mechanical means which will at the same time require less labor and be more sanitary than the conventional hydraulic cider press using press cloths. Screw presses tried for this purpose give a low yield of juice with a high percentage of suspended solids, necessitating removal by some means such as centrifuging. The large quantity of suspended solids necessitates frequent change of the bowl in an ordinary high speed centrifuge. Continuous solid-discharge centrifuges are expensive, but a combination of a screw press and a continuous solid-discharge centrifuge might eliminate the first pressing, which is the sloppy part of juice extraction and requires the most labor. A second or dry pressing would then be required to obtain a satisfactorily high yield of juice.

APPLE SIRUP

Various products of sirupy consistency are made from apple juice. They are distinguished as follows: If the juice is boiled down in an open vessel, the product obtained is boiled cider, and is rather dark and has a strong taste. If it is evaporated under vacuum, the product is called concentrated apple juice and is lighter in color and milder in flavor, although still sharp-

ly acid. If the acidity of the juice is removed or neutralized and the juice evaporated in vacuum, one of several types of apple sirup is produced.

Apple sirup made by the present commercial process, developed in the Eastern Regional Research Laboratory, is amber in color, very sweet, and bland. It has no distinctive flavor, not even that of apple, but is has a slightly bitter aftertaste, due to calcium malate. About 8,000,000 pounds of it have been produced in the last 3 years in this country and in Canada. The process in general is briefly outlined as follows: The apples are sorted, washed, and ground, and the juice is pressed out by a hydraulic press. The juice is treated with a slurry of hydrated lime until the pH is 8.0 to 8.5, heated to 175° F. (79° C.) to precipitate the pectin, and filtered. The clarified juice from the filter press is acidified with 1.3 sulfuric acid (or other acid) to a pH of 5.0 to 5.5 and then evaporated under vacuum to a sirup containing approximately 75 per cent of solids. Its consistency is about that of an invert sugar sirup of the same solids content. At 75° F. its viscosity ranges from 800 to 1100 centipoises, with an average of about 1000.

This apple sirup is the one used commercially for conditioning tobacco products. A better sirup, suitable for table sirup, is made by removing the acid instead of neutralizing it. The extracted juice before concentration is passed over a bed of anion exchanger, which absorbs the malic acid. Malic acid would be a by-product of this process once it is put into commercial operation.

APPLE ESSENCE

The process for recovery and concentration of apple esssence as developed at the Eastern Regional Research Laboratory consists of the following steps: (1) flash evaporation of a portion of the juice at atmospheric pressure; (2) mechanically separating the vapors from the unvaporized juice; and (3) fractionating the vapors to obtain a more concentrated flavor. The product is a colorless water solution of the volatile constituents of natural apple flavor concentrated between 100- and 200-fold.

FULL-FLAVORED CONCENTRATED JUICE

One of the most obvious uses of natural apple flavor is its addition to a concentrated juice to produce a full-flavored, natural apple juice upon reconstitution with water. The reconstituted juice is practically indistinguishable by taste and bouquet from freshly prepared juice.

FROZEN SLICED APPLES

Compensating in part for the inability to supply civilian demand for canned apples and apple sauce, there has been an increase in production of frozen sliced apples and frozen apple sauce. Means of preventing the darkening of frozen sliced apples have enabled their production to become established on a sound and growing basis. One and four-tenths million bushels of fruit are estimated to have been used in this way last season. Frozen apples are a relatively low cost product as compared with other frozen foods, all of which carry appreciable overhead. Therefore they cannot be economically transported long distances under high-cost refrigeration.

Frozen apples enable the pie baker to use suitable varieties in optimum condition throughout the year without varying his formula. In this connection chilled fresh slices deserve mention, as there exists a sizable business in this means of marketing fresh apples from storage. Owing to breakdown in texture storage fruit becomes less desirable in the late spring

just when the price of fresh slices must be advanced because of increased storage charges. The pie baker turns to frozen or canned apples, and then when the new crop of fruit becomes available the apple slicer must win his customers over again. Mimeograph AIC-57, which describes methods of preparing sliced apples for freezing or fresh sale, is available from the Western Regional Research Laboratory, Albany, California, under the title "Commercial Preparation and Freezing Preservation of Sliced Apples."

Production of frozen apple sauce is relatively small at present. The flavor is the same as that of sauce prepared from fresh apples, and when made from suitable tart varities is especially delightful.

POMACE

The present demand for pomace is excellent, as reflected by sale at twice the pre-war price. No small part of the incentive for drying is waste disposal, but sale as cattle feed is hardly profitable. In many cases one might just as well burn the pomace in Dutch ovens. Too little attention is paid to pectin quality by the pomace drier. If the demand for pomace for pectin manufacture is good and the quality satisfactory, it is sold for pectin If not, it is sold for cattle feed at a reduced price. The Eastern Regional Research Laboratory is studying factors affecting the quality of commercial pomace in an effort to improve methods of preserving pectin value. Segregation according to quality into a "pectin" grade and a "cattle-feed" grade could be made in preference to blending poor quality and good quality pomace to produce a pomace of uniform but mediocre quality. A premium would then be paid for the high quality "pectin" pomace, and the lower quality would be sold for cattle feed.

Four types of driers are in commercial use at present—kiln, rotary steam tube, Roto-Louvre, and belt type. The initial investment is less for the kiln type, but labor costs are high. Recent studies on drying pomace indicate that excellent pomace can be prepared in mechanical driers with automatic controls, thus reducing labor costs. An interesting development is a plan to use direct heat from coke-burning furnaces in a Roto-Louvre drier.

PECTINS

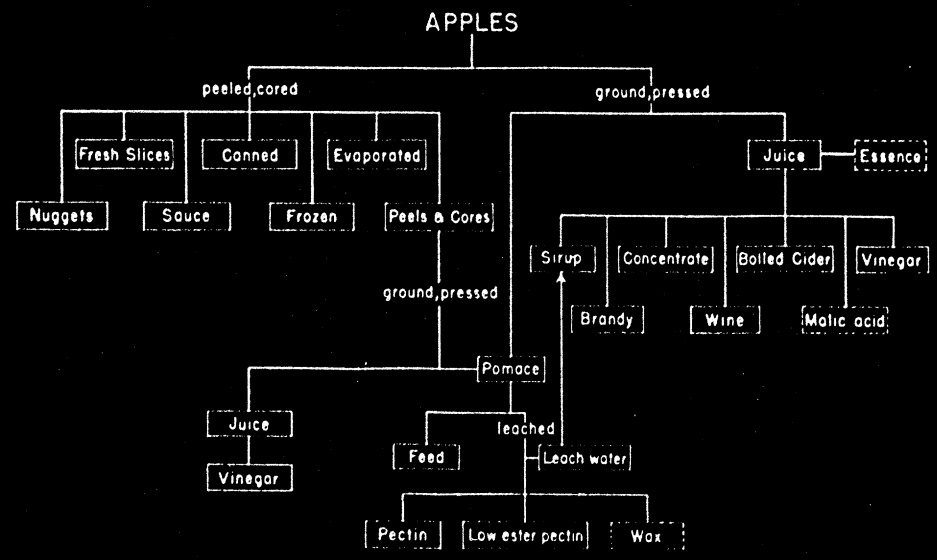
For many years housewives and manufacturers of commercial jelly and jam have been familiar with pectin. To the chemist it is known as high-ester pectin, but to the trade it is just pectin. It forms a firm jelly when used in a juice containing 65 per cent of sugar. Within recent years another type of pectin, called low-ester pictin, has been developed. It differs from the older type in that, if a little calcium is available in the juice, a jelly will form without the addition of sugar. Thus, with it, jellied fruit desserts and aspics can be made with a small proportion of sugar, or none at all.

Jellies made with 35 to 45 per cent of sugar have more of the natural fruit flavor than those with the customary 65 per cent. A 65 per cent sugar jelly is relatively self-preserving, in that micro-organisms grow slowly or not at all in it, whereas a jelly with less sugar must be packed sterile, and after opening must be kept under refrigeration or consumed within a few days. At present low-ester pectin is used in making a canned jellied fruit dessert for the armed forces. This is sterilized in the can in the conventional manner, and removed as a jelly, ready to serve. Such a procedure cannot be used with a gelatin-fruit product, since it will not solidify after the sterilizing heat treatment. The Army is leading the way in the acceptance of this article, having asked for 20 million cans of the product so far.

WHAT OF THE FUTURE?

If the accompanying chart had been drawn in 1920, some eight products would have been lacking. By 1930 two more could have been added. Since then, nuggets, frozen slices, low-ester pectin, and sirup have been developed, and the present decade may see apple essence added to the commercial list. We are not betting as yet on malic acid and wax. And there is reason to suppose that the research on apple products going on here and there will result in still other primary products from Apples, the King of Fruits.

APPLE PRODUCTS



LABOR COST IN PREPARING 100 LBS. OF APPLES MANDATORY WAGES 40¢ PER HOUR, SEASON 1942 APPALACHIAN AREA, U. S. A.

Size	No. of apples in 100 lbs.	Yield per 100 lbs. when pared and trimmed lbs.	Loss in lbs.	Cost of labor to prepare, 1942 season. 40¢ mandatory wage paid
100 lbs. 2¼"—2½"	530	66.3	33.7	$2.11
100 2½"	306	74.5	25.5	1.08½

Small apples cost $1.02½ more per 100 lbs. to secure 11% less product.

POSITION OF VARIETIES FOR CANNING AND SAUCE AS GROWN IN THE SHENANDOAH-CUMBERLAND AREA IN THE U. S. A.—A CANNER'S JUDGMENT

Very Good: York, Golden Delicious, Stayman, Grimes.
Good: Jonathan, Rome, Baldwin.
Fair: All other sour varieties.

Considered very good varieties—York is considered outstanding. It is fit to use for a long time; has high flavor; does not show bruises easily. **Stayman** has delicate texture. It has a shorter period than York when it is just right for use. It has deep seed cell cavities which often show mold. In coring for sauce the seed coats may break and

SHOWING THE QUANTITY OF APPLES USED BY PROCESSORS

Canned, Sauce, Dried, Frozen, Other uses

Stated in terms of fresh fruit in thousands of bushels, 48 lbs. each
Data released by B. A. E., U. S. D. A.

The years of war have forced an increasing interest in the processing of apples. Today whole crops are taken for processing to meet the requirements of the armed forces.

Fruit which formerly moved in fresh fruit channels is used.

The use of apples in this manner has now become a matter of prime importance. After deducting apples for home use and processing, the balance of the crop is available for movement in fresh fruit channels.

1,000 Bushels

	Canned	Dried	Frozen	Others [1]	Total Processed
1934	7,524	7,106		8,838	23,468
1935	7,732	9,146		14,176	31,054
1936	7,853	6,698		7,386	21,937
1937	9,266	8,646		15,877	33,789
1938	4,807	6,347		8,783	19,937
1939	9,110	8,172		16,043	33,325
1940	7,007	4,268		11,070	22,345
1941	12,338	6,165		15,884	34,387
1942	11,426	7,376		16,300	35,102
1943	6,662	6,692	1,004	9,957	24,315
1944	9,323	6,995	2,425	16,682	35,425
1942 Crop					
New England				800	800
New York	2,633	1,099		3,778	7,510
Pennsylvania	2,623	50		2,015	4,688
Virginia	1,624	370		2,520	4,514
West Virginia	691	186		606	1,483
Michigan	365			1,690	2,055
Washington	1,216	3,322		337	4,875
Oregon	365			361	726
California		2,234		767	3,001
Others	1,909	115		3,426	5,450
TOTALS	11,426	7,376		16,300	35,102

1/ Mostly fruit crushed for vinegar, cider, and juice. For the years 1934-42 includes quantity frozen.

	Canned	Dried	Frozen	Others [1]	Processed Total
1943 Crop					
New England	25			525	550
New York	1,743	502	114	2,851	5,210
Pennsylvania	1,734	74		1,027	2,835
Virginia	695	237	108	943	1,983
West Virginia	388	135		394	917
Michigan	360		90	1,486	1,936
Washington	871	2,764	320	216	4,171
Oregon	365		49	212	626
California	92	2,980	304	897	4,273
Others	389		19	1,406	1,814
TOTALS	6,662	6,692	1,004	9,957	24,315
1944 Crop					
New England	24			948	972
New York	1,736	437	571	3,961	6,705
Pennsylvania	2,360	50	300	1,390	4,100
Virginia	2,067	508	213	3,159	5,947
West Virginia	862	90	60	1,161	2,173
Michigan	316		259	1,625	2,200
Washington	710	3,822	322	446	5,300
Oregon	322	100	118	309	849
California	288	1,867	375	660	3,190
Others	638	121	207	3,023	3,989
TOTALS	9,323	6,995	2,425	16,682	35,425

Sec. Note: Certain trade data would indicate that in some items these figures may be incomplete.